

WHAT IS CLAIMED IS:

1. Device for user interaction via object location in conjunction with an electronically refreshable display screen, the device comprising:

a transparent sensing arrangement of detectors located at said electronically refreshable display screen for detecting a location of said object, said detectors having outputs, and

an arrangement of amplifiers for producing differential signals associated with said outputs, said differential signals being signals indicative of a differential between at least two of said outputs, said device being operable to use said signals in said interaction.

2. The device of claim 1, wherein said amplifiers are differential amplifiers.

3. The device of claim 1, wherein said arrangement of detectors is configured for detecting an electric field.

4. The device of claim 1, wherein said electronically refreshable display screen comprises a flat panel type display screen.

5. The device of claim 1, wherein the object is a pointing device.

6. The device of claim 5, wherein the pointing device is a stylus.

7. The device of claim 1, wherein the object is a gaming piece.

8. The device of claim 1, integrated with a flat panel display.

9. The device of claim 1, packaged as an accessory to a mobile computer.

10. The device of claim 1, wherein the transparent sensing arrangement comprises at least one organic conductive foil.

11. The device of claim 1, wherein the transparent sensing arrangement comprises at least one ITO foil.

12. The device of claim 1, further comprising at least one high pass amplifier connected between sensors of said sensing arrangement and said amplifier arrangement.

13. The device of claim 1, wherein said transparent sensing arrangement comprises a grid of straight line sensors.

14. The device of claim 1, wherein said arrangement of differential amplifiers comprises a plurality of differential amplifiers each having a first differential input and a second differential input, and wherein said first differential input is connected to an output of a first sensor, and said second differential input is connected to an output of a second sensor beyond a stylus effective field of said first sensor.

15. The device of claim 14, wherein said second sensor is at a minimal distance beyond said stylus effective field of said first sensor.

16. The device of claim 14, wherein each object is configured to produce a field able to affect several neighboring sensors and wherein said respective first and second sensors per amplifier are selected such that different object positions generate outputs at different combinations of amplifiers, thereby permitting different amplifier combinations to be decoded to individual sensors.

17. The device of claim 14, further being configured to detect phases of signals of said sensors, thereby to distinguish between signals from different sensors.

18. The device of claim 1, wherein said arrangement of differential amplifiers comprises a plurality of differential amplifiers each having a first differential input and a second differential input, and wherein each of said differential

40

inputs is connected to at least two outputs, each of said at least two outputs being associated with respectively non-neighboring sensors.

19. The device of claim 18, wherein each object is configured to produce a field able to affect several neighboring sensors and wherein said respectively non-neighboring sensors per amplifier are selected such that different object positions generate outputs at different combinations of amplifiers, thereby permitting different amplifier combinations to be decoded to individual sensors.

20. The device of claim 18, further being configured to detect phases of said sensor signals, thereby to distinguish between signals from different sensors.

21. The device of claim 14, wherein each of said differential inputs are connected to at least two outputs, each of said at least two outputs being associated with respectively non-neighboring sensors.

22. The device of claim 1, wherein said object is a passive object, the digitizer further comprising an excitation arrangement located about said screen for sending an excitation signal to said object, thereby to energize said object to generate an electric field.

23. The device of claim 22, wherein said excitation arrangement is controllable to generate said excitation signal at a dynamically variable frequency.

24. The device of claim 22, wherein said excitation arrangement is controllable to generate said excitation signal at a dynamically variable amplitude.

25. The device of claim 22, wherein said excitation arrangement is controllable to provide a dynamically variable excitation duration.

26. The device of claim 22, further comprising blanking controllability for blanking of detection during output of said excitation signal.

41

27. The device of claim 26, wherein said blanking controllability is operable to continue said blanking for a predetermined delay after output of said excitation signal.

28. The device of claim 1, further comprising a compensation database in which differences in conductivity between individual sensors are encoded.

29. The device of claim 1, further comprising a compensation database in which fixed variations in electromagnetic interference over said sensing arrangement are encoded.

30. The device of claim 28, wherein said compensation database further encodes fixed variations in electromagnetic interference over said sensor arrangement.

31. The device of claim 1, further comprising an object movement history arrangement for storing data of immediately preceding movement of said object, and using said data in processing of a current location of said object.

32. The device of claim 31, wherein said processing comprises filtering according to possible hand movements of a user from a prior measured position.

33. The device of claim 31, wherein said processing comprises filtering according to likely hand movements of a user from a prior measured position.

34. The device of claim 31, wherein said processing comprises smoothing a locus of said object.

35. The device of claim 31, further comprising a predictor, associated with said object movement history arrangement for using data of said object movement history arrangement to predict a future locus of said object.

36. The device of claim 35, wherein said object movement history arrangement with said predictor comprise a slow movement tracker and wherein there

42

is further provided a fast movement tracker for tracking said object, said device being operable to initially set an output of said fast movement tracker as a locus of said object and subsequently to use an output of said slow movement tracker to correct said locus.

37. The device of claim 1, wherein said object produces an exponentially decaying signal, the digitizer further comprising signal multiplication functionality for multiplying said decaying signal by an opposite, exponentially rising signal, thereby to cancel out frequency side lobes and to increase frequency resolution of said digitizer.

38. The device of claim 1, further comprising transform functionality for transforming a detected time domain signal into a frequency domain signal, and wherein transform functionality is operable to select a transform type dependent on a likely number of frequencies to be detected.

39. The device of claim 1, further comprising transform functionality for transforming a detected time domain signal into a frequency domain signal, and wherein transform functionality is operable to dynamically select a transform type dependent on a current number of frequencies to be detected.

40. The device of claim 38, wherein said transform types for selection comprise the Fast Fourier Transform and the Discrete Fourier Transform.

41. The device of claim 39, wherein said transform types for dynamic selection include the Fast Fourier transform and the Discrete Fourier Transform.

42. The device of claim 41, comprising a threshold, associated with said transform functionality, for setting a threshold number of frequencies, said threshold for switching between said Fast Fourier transform for a high number of frequencies relative to said threshold and said Discrete Fourier transform for a low number of frequencies relative to said threshold.

43

43. A passive stylus for use with a digitizer, comprising:
an outer stylus shaped housing having a front tip,
a resonator arrangement having a predetermined resonant frequency, and
a gap at said tip across which said resonator arrangement is coupled, to create
an electric field concentration in the vicinity of said front tip.

44. The passive stylus of claim 43, further comprising a ferrite coil.

45. The passive stylus of claim 43, wherein said resonator is remotely
located from said tip and coupled thereto via a conductor.

46. The passive stylus of claim 43, further comprising switchable
components to contribute to said resonator arrangement to modify said predetermined
resonant frequency to indicate different mode settings of said stylus.

47. The passive stylus of claim 43, further comprising a modulator for
providing detectable variations in said electric field according to different mode
settings of said stylus.

48. The passive stylus of claim 43, comprising a reverse tip located at a
second end remote from said front tip, a conductor arrangement extending to said
reverse tip.

49. The passive stylus of claim 48, wherein the geometry in the vicinity of
said reverse tip is different from the geometry in the field of said front tip, thereby to
provide a detectable difference between said front and reverse tips.

50. The passive stylus of claim 48, further comprising switchable
components associated with said reverse tip, to contribute to said resonator
arrangement to modify said predetermined resonant frequency to indicate different
mode settings of said stylus.

44

51. The passive stylus of claim 47, wherein said detectable variations are variable delays in coupling of said electric field to said gap.

52. The passive stylus of claim 43, further comprising a normally closed switch associated with said front tip.

53. A digitizer for user interaction with an electronic device having an electronically refreshable display screen, the digitizer comprising:

a transparent sensing grid located on said electronically refreshable display screen for detecting electronic signals from an object, said grid having a plurality of outputs, and

an arrangement of amplifiers wherein each amplifier is connected over at least two outputs of said sensing grid to produce an output signal being a function of said at least two outputs.

54. A digitizer for user interaction via an electronically passive object with an electronically refreshable display screen, the digitizer comprising:

a transparent sensing arrangement of detectors located at said electronically refreshable display screen for detecting an electric field of said object, said detectors having outputs,

an arrangement of amplifiers associated with said outputs, and

an excitation arrangement for generating excitation signals for said passive object to enable said passive object to generate or issue said electric field, said excitation arrangement being dynamically controllable to change a sampling rate at which said excitation signal is generated or issued.

55. The digitizer of claim 54, further comprising a state detector to detect a state of said object, thereby to carry out said dynamic control of said sampling rate.

56. The digitizer of claim 55, wherein said state detector is operable to detect at least one of a group comprising a user-switched state, a contact state of said object with a surface, a contact state of said object with said screen, a right click and eraser action.

57. The digitizer of claim 54, further comprising a frequency detector to detect a number of object frequencies present, said number being usable in said dynamic control of said sampling rate.

58. A digitizer for user interaction via an electronically passive object with an electronically refreshable display screen, the digitizer comprising:

a transparent sensing arrangement of detectors located at said electronically refreshable display screen for detecting an electric field of said object, said detectors having outputs,

an arrangement of amplifiers associated with said outputs, and

an excitation arrangement for generating and issuing an excitation signal for said passive object to enable said passive object to generate said electric field,

and wherein said arrangement of amplifiers is controllable, in association with said excitation arrangement, with a blanking period such that said arrangement of amplifiers is prevented from detecting during issuance of said excitation signal.

59. A digitizer for user interaction via an object with an electronically refreshable display screen, the digitizer comprising:

a transparent sensing arrangement of detectors located at said electronically refreshable display screen for detecting an electric field of said object, said detectors having outputs, and

an arrangement of amplifiers associated with said outputs, each amplifier being connected to outputs of at least two respectively non-neighboring sensors, said respectively non-neighboring sensors per amplifier being selected such that different object positions generate outputs at different combinations of amplifiers, thereby permitting different amplifier combinations to be decoded to individual sensors.

60. A digitizer for user interaction via an electronically passive object with an electronically refreshable display screen, the digitizer comprising:

a transparent sensing arrangement of detectors located at said electronically refreshable display screen for detecting an electric field of said object, said detectors having outputs,

46

an arrangement of amplifiers associated with said outputs, and

an excitation arrangement for generating an excitation signal for said passive object to enable said passive object to generate said electric field, said excitation arrangement being dynamically controllable to change a property of said excitation signal.

61. The digitizer of claim 60, wherein said property is one of frequency, amplitude and phase.

62. The digitizer of claim 60, wherein said arrangement is operable to use a state of said object to set said dynamically controllable property.

63. The digitizer of claim 62, wherein said state comprises at least one of a user-switched state, a contact state of said object with a surface, a contact state of said object with said screen, a current velocity of said object, a current acceleration state of said object, and a current orientation of said object.

64. A device for user interaction via object location in conjunction with an electronically refreshable display screen, wherein said object is a passive electromagnetic stylus, and said screen is overlaid with a transparent sensing arrangement.

65. The device of claim 64, wherein said transparent sensing arrangement is configured for detecting an electric field.